PROCESS AND ASSEMBLY FOR IDENTIFYING AND TRACKING ASSETS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION:

The present invention relates to processes and assemblies for identifying and tracking assets, such as tubulars, equipment and tools used in subterranean wells, and more particularly, to processes and assemblies for identifying and tracking such assets which facilitates accurate input of data into a data base.

DESCRIPTION OF RELATED ART:

Tubulars are commonly employed in subterranean wells. During drilling of a subterranean well bore, a drill bit is secured to one end of a drill string which is made up of individual lengths of drill pipe. These lengths are conventionally secured together by means of a threaded collar. After the drill bit is secured to a first length of drill pipe, the bit and first length of drill pipe are lowered to the ground and usually rotated to permit the bit to penetrate the earth. Drilling fluid is circulated via the interior of the pipe to the drill bit to lubricate the bit and to carry cuttings back to the drilling rig at the surface of the earth via the annulus formed between the bore hole being drilled and the drill pipe. As drilling progresses, additional lengths of drill pipe are secured to the uppermost length of drill pipe in the well bore. As this process continues, a drill string is formed that is made up of individual lengths of drill pipe secured together. Once the well bore is drilled to the desired depth, the well bore is completed by positioning a casing string within the well bore to increase the integrity thereof and provide a path for producing fluids to the surface. The casing string is normally made up of individual lengths of relatively large diameter metal tubulars which are secured together by any suitable means, for example screw threads or welds. Usually, each length of casing is provided with male screw threads at each end thereof and individual lengths of casing are joined together by means of a collar having female screw threads at each end thereof. Conventionally, after the casing string is cemented to the well bore face and perforated to establish fluid communication between the subterranean formation and the interior of the casing string, a production tubing string is positioned within the casing string to convey fluids produced into the well to the surface of the earth. Tubing strings

are conventionally made up of individual lengths of relatively small diameter tubing secured together by collars in a manner as described above with respect to casing. Tubing strings may also be used to convey fluids to treat the well or a subterranean formation of interest or to convey tools or equipment, such as packers, plugs, etc., that are needed to complete or work over a well

Tubulars are transported to the well site in anticipation of an operation and are temporarily stored there until deployed into a well. At the well site, each length of tubular is measured or "tagged" to determine the exact length thereof. Because each tubular as manufactured usually varies in length, it is important to determine and know the exact length thereof so that the total length of a given tubular string that is positioned in a subterranean well is known. As the first tubular of a given string is positioned in a well, the tubular is designated with a first number, e.g. 1, and the length thereof is manually recorded at the well site into either a paper or computer data base. As each subsequent individual length of tubular is secured to the tubular string already positioned in the well, the next consecutive number that is assigned to that tubular and its exact length is also manually recorded into the data base at the well site. In this manner, the exact number of tubulars that make up a given string positioned in a subterranean well and the exact length of the string is known. The compilation of a data base in this manner is also desirable so as to maintain an accurate history of the usage of tubulars, equipment and/or tools. Such history of usage can be used to provide maintenance and predict potential problems. However, problems routinely occur with this procedure due to manual error(s) in entering into the data base tubular length(s) that are not part of the tubular string positioned in a well, in entering the wrong sequence of individual tubular lengths that make up a string, and/or in failing to enter an individual tubular length(s) that is part of a tubular string positioned in a subterranean well. Such errors lead to time consuming problem solving, while expensive rigs are often present at the well site, to determine the precise depth of the well, of a certain individual length of casing, and/or of a certain downhole tool. Further problems occur with this conventional method when tubulars are withdrawn from the well bore, temporarily stored on site and subsequently used in a different operation at that well or transported and used in a different well. In accordance with this

conventional method, individual lengths of tubulars removed from a well are stacked at the well site without any consideration given to the number assigned to that tubular as run into the well. The individual length of tubulars are not actually physically marked with a designation number and marking such tubulars as they are being pulled from a well is not practical since the rig necessary for performing this operation is expensive. In some instances, individual lengths of drill pipe are provided with a unique serial number from the manufacturer which is entered into the data base as the drill string is being made up. However, such entry is expensive and plagued by manual errors, and often, the serial number of an individual length of drill pipe is not easily found or illegible if found due to rust, corrosion, wear, etc.

In an effort to automate the data input process and to provide a completely accurate information data base, a system has been developed to track asset inventory wherein an electronic tag, such as a passive radio frequency chip, is attached to articles of manufacture that are used in the oil & gas industry. A hand held wand is employed by field personnel to read such electronic tag and the code gleaned during such reading is transferred by cable to a hand held portable terminal. This information is then sent to a personal computer. This system is commercially available from Den-Con Tool Company. of Oklahoma City, Oklahoma under the trade name designation "Print System". However, electronic tags, such as a passive radio frequency chip, do not transmit through steel, and therefor, require field personnel to position the hand held wand adjacent and close to the tag to read it. Thus, the use of this system at field locations, such as drilling and completion rigs, offshore platforms etc., has proved to be inefficient since field personnel must first locate the position of the electronic tag and then properly position the wand in extremely close proximity to the tag, sometimes repeating the procedure to ensure that the tag is properly read. This is time consuming and expensive.

Thus, a need exists for an identification and tracking method wherein individual lengths of tubulars, pieces of equipment or tools are accurately identified and inventoried prior to deployment in a given subterranean well, as positioned in a well and/or as stacked at a well site after being pulled from a well and awaiting deployment in the same or different wells. A further need exists for

effectively eliminating errors in data base entry for information about individual lengths of tubulars, equipment and/or tools. A still further need exists for eliminating time delays associated with automated reading of radio frequency identification devices employed to identify and track tubulars or other tools or equipment.

SUMMARY OF THE INVENTION

To achieve the foregoing and other objects, and in accordance with the purposes of the present invention, as embodied and broadly described herein, one characterization of the present invention may comprise an assembly is provided for identifying and tracking an asset. The assembly comprises a responding device adapted to be connected to an asset and an antenna electrically connected to said responding device.

In another characterization of the present invention, an assembly is provided for use as a fluid conduit. The assembly comprises a tubular, a responding device connected to the tubular, and an antenna electrically connected to the responding device.

In yet another characterization of the present invention, an assembly is provided for use as a fluid conduit. The assembly comprises a tubular, a collar releasably secured to one end of the tubular, the collar comprising a generally tubular body, a responding device connected to the generally tubular body, and an antenna electrically connected to the responding device.

In still another characterization of the present invention, a process for identifying and tracking assets is provided which comprises positioning a transceiver in proximity to an asset having a responding device and an antenna electrically connected to the responding device so as to permit communication between the transceiver and the responding device via the antenna.

In yet still another characterization of the present invention, a process for identifying and tracking tubulars is provided which comprises positioning a transceiver and a tubular having a responding device and an antenna electrically connected to the responding device in proximity to each other without regard to the rotational orientation of the tubular so as to permit communication between the transceiver and the responding device via the antenna.

In yet still another characterization of the present invention, a process is provided for identifying and tracking assets which comprises positioning an asset having a responding device connected thereto within a transceiver having a generally annular antenna so as to permit communication between the transceiver and the responding device via said antenna.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description, serve to explain the principles of the invention.

In the drawings:

FIG. 1 is a partially cutaway, perspective view of one embodiment of the process and assembly of the present invention;

FIG. 1A is a blown up portion, as outlined in FiG. 1, of the embodiment of the process and assembly of the present invention that is illustrated in FIG. 1;

FIG. 2 is a partially cutaway, perspective view of another embodiment of the process of the present invention;

FIG. 2A is a blown up portion, as outlined in FiG. 2, of the embodiment of the process and assembly of the present invention that is illustrated in FIG. 2:

FIG. 3 is a partially cutaway, perspective view of still another embodiment of the present invention;

FIG. 3A is a blown up portion, as outlined in FiG. 3, of the embodiment of the process and assembly of the present invention that is illustrated in FIG. 3; and

FIG. 4 is a partially sectioned, perspective view of a responding device being read by a transceiver in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As utilized throughout this specification, the term "asset" refers to any article of manufacture or device, which includes, but is not limited to, tubulars, equipment and tools designed to be run on, connected to and/or operated by

tubulars. As utilized throughout this specification, the term "tubular" refers to an individual length of any generally tubular conduit for transporting fluid, particularly oil, gas and/or water in and/or from a subterranean well and/or transportation terminal. When referring to a "tubular" which is used in a subterranean well, tubulars are usually secured together by means of collars to form a string of tubulars, such as a tubing string, drill string, casing string, etc., which is positioned in a subterranean well as utilized, at least in part, to transport fluids. Environments other than a subterranean well in which tubulars may be used in accordance with the present invention, include, but are not limited to, pipelines and sewer lines.

Referring to FIG. 1, a portion of two tubulars are illustrated as 2 and 6. Each end of tubulars 2 and 6 may be provided with screw threads. As illustrated in FIG. 1, the outer surface of one end 3 and 7 of tubulars 2 and 6, respectively, are provided with screw threads 4 and 8. A collar 10 is utilized to secure ends 3 and 7 of tubulars 2 and 6 together. The internal surface of collar 10 is provided with screw threads 12 which threads 4 and 8 are mated with.

In accordance with the embodiment of the present invention as illustrated in FIG. 1, the outer surface of collar 10 is provided with a groove or trough 14 which extends about substantially the entire circumference or periphery of collar 10. A responding device 20, for example a radio frequency identification device (known as a "RFID"), is positioned in groove 14. This radio frequency identification device 20 may be in the form of a passive radio identification device (know as a "PRID"). Such PRIDs are conventional and are used for merchandise security in the retail industry, library security, etc., and generally comprise a solid state printed circuit which is configured to resonate upon receipt of radio frequency energy from a radio transmission of appropriate frequency and strength. Such devices do not require any additional power source, as the energy received from the transmission provides sufficient power for the device to respond with a weak and/or periodic reply transmission so long as it is receiving an appropriate transmission.

Alternatively, the responding device 20 may be in the form of an active device, requiring a separate source of electrical power (e.g., electrical storage battery or other electrical power means). Such devices are also conventional,

and may be configured to draw practically no electrical power until a radio frequency signal is received, whereupon they are electrically energized to produce a responding transmission.

In accordance with one embodiment of the present invention, an antenna 24 is electrically connected to the responding device 20 by any suitable means, such as by silver solder or welds, and is positioned within groove 14 and extends about substantially the entire circumference or periphery of collar 10. Antenna 24 may be constructed of any suitable electrically conductive material as will be evident to a skilled artisan, for example suitable nickel based alloys such as INCONEL. Preferably, device 20 and antenna 24 are incorporated in a TEFLON ring which is positioned in groove 14 and forms a fluid tight seal through which an appropriate radio frequency signal may be transmitted and received.

A radio frequency transmitter and receiver (i.e. a transceiver) 40 is provided (FIG. 4). Transceiver may be in the form of a hand held portable terminal 42 connected to a hand-held wand 44 by means of cable 43. In operation, as a tubing string that comprises tubulars joined together, for example by collars, is being moved into position for use, wand 44 may be manually held adjacent the tubulars without regarding for the specific orientation of a responding device on a given tubular. Alternatively, where the process permits, wand 44 may be secured in a stationary position that is adjacent the tubulars and held in that position by any suitable mechanical means as will be evident to a skilled artisan. Transceiver 40 constantly transmits a radio frequency signal in the direction of the tubing string. As antenna 24 on a given collar 10 passes adjacent wand 44, the signal emanating from wand 44 is received by antenna 24 and transmitted to radio frequency identification device 20. Device 20 detects this signal and sends a radio frequency response that is transmitted through the antenna 24 so as to be received by transceiver 40. In this manner, each tubular joint and its position is identified. By using an antenna in accordance with the present invention not only is the orientation of tubulars (and therefor responding devices) as well as the corresponding transceiver irrelevant, but the antenna is able to receive and broadcast radio frequency signals at greater distances than by using only a radio frequency identification device, e.g. up to 15 inches or more with an antenna as compared to 3 inches for an RFID device alone.

In another embodiment of the present invention that is illustrated in FIG. 2, a bore or hole 11 is provided in collar 10 and a RFID 20 is positioned in bore 11 and is electrically connected to an outer antenna 24 by any suitable means, for example by silver solder or welds 25. In accordance with the embodiment of FIG. 2, a generally annular inner antenna 26 is positioned in a ring 18 that is provided with screw threads 19 on the outer surface thereof. Threads 19 are mated with threads 12 on collar 10 such that ring 18 is positioned in the gap between the ends 3, 7 of tubulars 2, 6, respectively, as mated with collar 10. Inner antenna 26 is electrically connected with RFID by any suitable means, for example a silver solder or welds 27. The operation of this embodiment with respect to use of a transceiver 40 that is positioned outside of the tubulars is identical to that described with respect to FIGS. 1 and 4 above. However, the embodiment of FIG. 2 may also be used in conjunction with a transceiver that is transported through the bores of the tubulars (not illustrated). As thus constructed and assembled, radio frequency signals from transceiver(s) may be received from the exterior of tubulars and adjoining collars by means of outer antenna 24 and/or from the interior of tubulars and adjoining collars by means of inner antenna 26 and information from RFID 20 may be transmitted via antenna 24 to transceiver(s) located external to the tubulars and adjoining collars and/or via antenna 26 to transceiver(s) located internal to the tubulars and adjoining collars. In this manner, information transmission can occur to and/or from the exterior and/or the interior of the tubulars.

While responding device 20 and antennas 24 and 26 have been described above as connected to a collar 10, it is within the scope of the present invention to connect responding device 20 and antennas 24 and/or 26 directly to a tubular and/or to tools, equipment and/or devices, especially those used in conjunction with tubulars, in a manner substantially similar with that described above with respect to collar 10. For tubulars, such direct connection is mandatory where collars are not utilize to secure individual tubulars together as is often the case with drill strings where individual tubulars are connected to each other.

It is also within the scope of the present invention to utilize a conventional responding device, for example a RFID, without an associated antenna. As

illustrated in FIG. 3, a RFID 20 is positioned within a bore or hole 11 formed in the outer surface of collar 10. A commercially available epoxy is placed in the bore or hole 11 and cured thereby encapsulating RFID device 20 in a fluid tight seal through which an appropriate radio frequency signal may be transmitted and received. In this embodiment, a transceiver 50 is employed which is sized and configured to permit the passage of tubulars therethrough. As illustrated, transceiver 50 is configured in a ring like shape that has an annular groove 51 formed in the inner surface thereof. An antenna 52 for the transceiver is positioned within groove 51 and extends substantially the entire length of the groove. In this embodiment, tubulars equipped with a conventional RFID may be passed through transceiver 50 with the antenna 52 ensuring that radio frequency communication between the transceiver and the RFID occurs without regard to rotational orientation of the tubulars.

While the use of an antenna in accordance with the embodiments of the present invention has been described herein only in conjunction with tubulars, it will be evident to a skilled artisan that the antenna may be used in conjunction with equipment, tools, and other devices that are secured to tubulars or to any asset that is required to be identified and tracked by use of a transceiver. Examples of such equipment, tools and devices used in conjunction with tubulars used in pipelines, subterranean wells or other fluid transmission lines, are bits, packers, plugs, pigs, valves, landing nipples, profiles, disconnects, ported subs, perforated nipples and polished bore receptacles.

While the foregoing preferred embodiments of the invention have been described and shown, it is understood that the alternatives and modifications, such as those suggested and others, may be made thereto and fall within the scope of the invention.